VOLUME III
SYSTEMS PHASE

CHAPTER 1
INTRODUCTION TO SYSTEMS TESTING

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1.1 INTRODUCTION

The Systems Phase of the USAFTPS curriculum is an introduction to fundamental theory and applications used to design, build, and evaluate current aircraft systems. During this phase you will be exposed to the basic theory of aircraft systems, a wide variety of aircraft and their systems, and to flight test techniques used in systems evaluation.

The purpose of systems testing is to develop operationally suitable combat or support aircraft through the use of effective on-board aircraft systems. Systems testing covers a large and complex field. These tests include weapons, fire control, electronic countermeasures (ECM), communications, navigation, egress, environmental control, flight controls, engine, instruments and crew station analysis, plus support and test equipment for these systems. Systems testing includes not only evaluation of individual aircraft systems, but the integration of these systems with each other and into the basic airframe to provide an operationally capable machine. In short, nearly anything not included in performance and flying qualities can be considered systems test.

The test pilot and Flight Test Engineer/Navigator (FTE/N) should approach systems testing with the primary objective of answering the question: "What are the goals of this system and how well does the system meet these goals?" The expected performance for any system should include goals for operational application, reliability and maintainability and systems interaction, in addition to measuring how well a given system meets its technical specification.

The one constant in systems testing is that new systems have improvements in technology for which there may not exist a "standard" test method or technique. As a result, this most important phase of the test environment also places the greatest demands on the technical competence, ingenuity, and aggressiveness of the test pilot and FTE/N. Technical competence is directly related to how much time is devoted to researching a given system. The test team must become an expert on the "nuts and bolts" of that system's operation as well as the operation of similar systems. The impact of any system on other aircraft systems (systems integration) must also be closely monitored.

The field of systems testing is constantly changing. The academic curriculum is purposely flexible to keep abreast of current developments. Course content is based on current trends, feedback from test centers on educational requirements, and in-house estimates of what will be required for future systems testing. Textbooks and handouts supplied for this phase contain basic information on basic aircraft systems, systems integration, and other systems subjects. When assigned a system project in the test environment, it will be up to the test pilot/FTE/N to supplement his knowledge of the subject with specific information on the equipment being evaluated.

Perhaps 80% or more of all flight testing done today is directly related to systems. Graduates of the USAFTPS should expect to spend the majority of their research and development tour in this area and should endeavor to develop the strongest foundation possible in system knowledge in order to contribute to this portion of developmental test.

1.2 TYPES OF AIRCRAFT SYSTEMS

The systems of modern aircraft cover a very large field. Only some will be covered in the USAFTPS curriculum; there simply isn't time to do it all. Below is a list of some of the systems you may be called upon to evaluate in your flight test career (Items with astericks are taught in the curriculum):

1. *Avionics Integration
2. Chemical Defense
3. *Cockpit Displays/Controls (Human Factors)
4. Communications - Radios (Secure, Jam-Resistant)
    a. Data Link
5. *Electronic Combat (EC)
    a. Warning Receivers
    b. Electronic Counter Measures (ECM)/Counter-Counter Measures (ECCM)
    c. Chaff/Flares
6. *Electro-Optics (E-O)/Infrared (IR)
    a. Air-to-air Search/Track
    b. Air-to-ground Navigation/Targeting
7. Electrical Supply
8. Environmental Control (ECS)
9. Flight Control
10. Fire Suppression
11. Hydraulic Supply
12. Magnetic Anomaly Detectors (MAD)
13. *Navigation - Inertial (INS)
    a. Ground-based
    b. Global Positioning Satellites (GPS)
    c. Terrain Matching
14. Oxygen Supply
15. *Radar
    a. Air-to-Air
    b. Air-to-Ground

c. Weather
d. Terrain Following
e. Altimeters
f. Non-Radar (Stealth)

16. Reconnaissance
    a. Film Cameras
    b. Television cameras
    c. Radar
    d. Infrared
17. Simulator Systems
18. Sonabouys
19. Weapons Delivery
20. Weapons Systems
    a. Rails/Racks/Dispensers
    b. Rockets/Missiles
    c. Cannons
    d. Bombs (Cluster, Retarded, Guided, General Purpose)
    e. Guided Bombs (Laser, TV, E-O, Satellite, Wire)

The courses offered are considered the most important subjects to fill the limited time available for instruction. If you are assigned a test project requiring expertise in other systems, it will be up to you to acquire the necessary knowledge.

Academics also consist of ground laboratory training (radar, electro-optics) and flight test technique briefings, as well as simulator evaluations and contractor visits where systems are developed and built.

Reports will be required for flights on the Avionics Systems Test Training Aircraft (ASTTA), the A-7 Systems Evaluation flight, and qualitative system evaluation flights.

1.3 SYSTEMS FLIGHTS

The systems test phase is less flight intensive than performance and flying qualities phases. However, the experiences gained during these few flights are very important to your test flying career. The centerpiece of systems flights is the ASTTA, an NC-131H outfitted with Radar, INS, IR, TV, and E-O weapons sensors. In this aircraft, basic techniques for flight test in all these systems will be demonstrated and practiced. Heads-up display symbology will be investigated in the NT-33 aircraft.

Exposure to a variety of old and new systems will be part of the qualitative evaluation program. A standard series of air-to-air and air-to-ground evaluations will be supplied so comparisons can be made between capabilities of similar systems. Finally, students will fly F-16 and A-7 systems evaluation flights to demonstrate the ability to perform a rapid, yet broad evaluation of fighter systems suite.

For more detail on systems test phase flights, see the Systems Phase Planning Guide.